DER-CAM

DECISION SUPPORT TOOL FOR DECENTRALIZED ENERGY SYSTEMS

ANALYTICS | PLANNING | OPERATIONS

Presented by
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Partners: Brookhaven National Laboratory, EPRI, Fort Hunter Liggett (US DoD), Massachusett Institute of Technology (MIT), MIT Lincoln Laboratory, NEC, Public Service New Mexico, TriTechnic, University of New Mexico, University of San Diego, Universidad Pontificia Comillas – IIT

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What is DER-CAM?

Decision support tool for decentralized energy systems

- Optimal energy supply solutions for buildings and microgrids
- Optimal dispatch of existing energy supply technologies in buildings and microgrids

DER-CAM is…

- *A physically-based economic optimization model*
  - Find most cost-effective mix of generation and storage + dispatch that minimizes costs / CO_2 emissions
  - Decisions consider load management options such as load shifting, load scheduling, load shedding
  - Constrains force energy balance and technology behavior
  - Written as a MILP, implemented in GAMS/ CPLEX

DER-CAM is not…

- *A power flow model*
- *A simulation model*

What is DER-CAM?

Two main branches

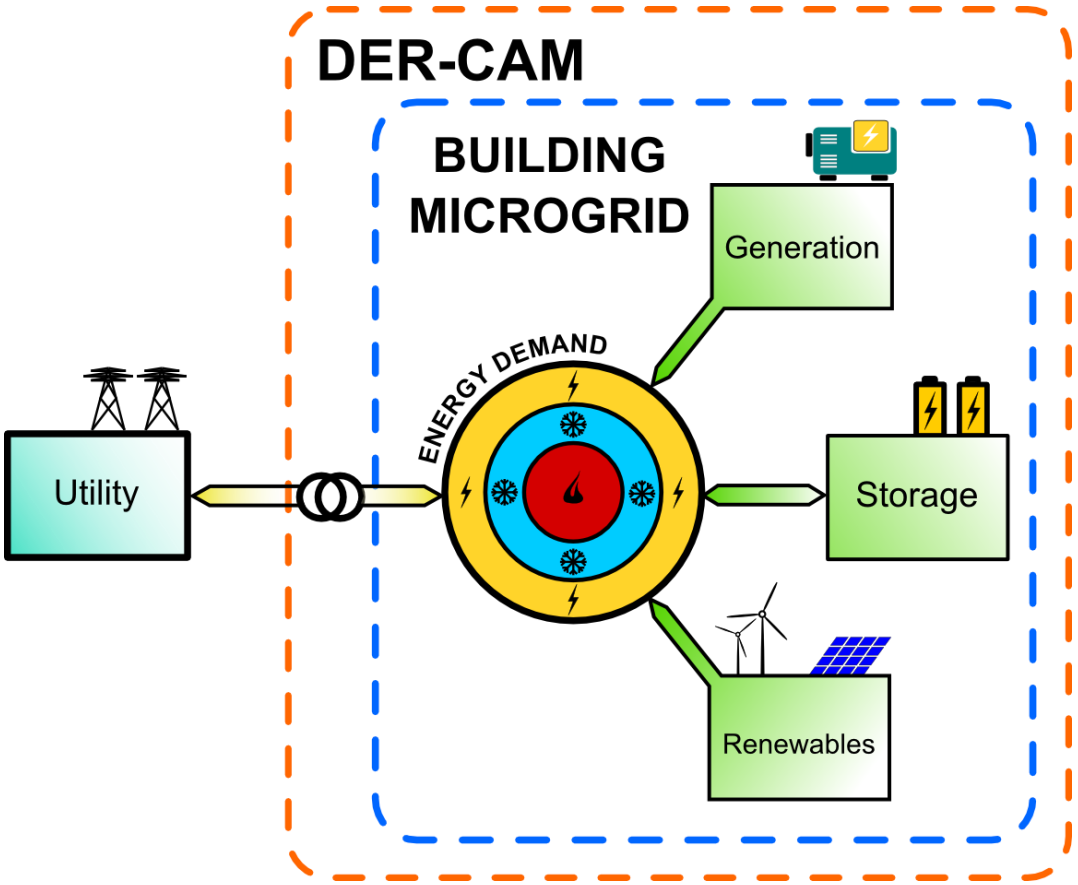
- Investment and Planning DER-CAM
  - Considers hourly loads of representative day-types based in historic or simulated data
  - Finds optimal investment decisions for a representative year, or investment timeline up to 20 years in the future
  - Investment decisions are based in a bottom-up approach: optimized dispatch for representative day-types
  - Technologically neutral

- Operations DER-CAM
  - Considers higher resolution time steps (5 min to 1 hour)
  - Finds optimal dispatch of local energy resources on a week-ahead basis
  - Uses existing load information and weather forecasts to forecast loads
  - Can be used to feed data to a microgrid controller (eg. SCADA Systems)

What to expect from (I+P) DER-CAM?

- Feasibility studies
  - DER-CAM allows quick assessments of investment options
- What-if analysis
  - Changing simple options in DER-CAM allows analyzing different settings, e.g. ZNEB
- Energy policy (subsidies and other benefits)
  - Indirect impact of implementing technology-specific incentives
  - Gauging subsidy values that change optimal technology mix
- Energy consulting

What is DER-CAM?



Features / Technologies

Distributed Generation
Combustion engines, fuel cells, micro-turbines, CHP, photovoltaic and solar thermal panels

Energy Storage
Stationary storage, electric vehicles, heat storage, cooling storage

Energy Management
Demand response, load shifting, load shedding

Passive technologies
Building shell replacements (windows, doors, insulation)

What is DER-CAM?

Currently over 400 users

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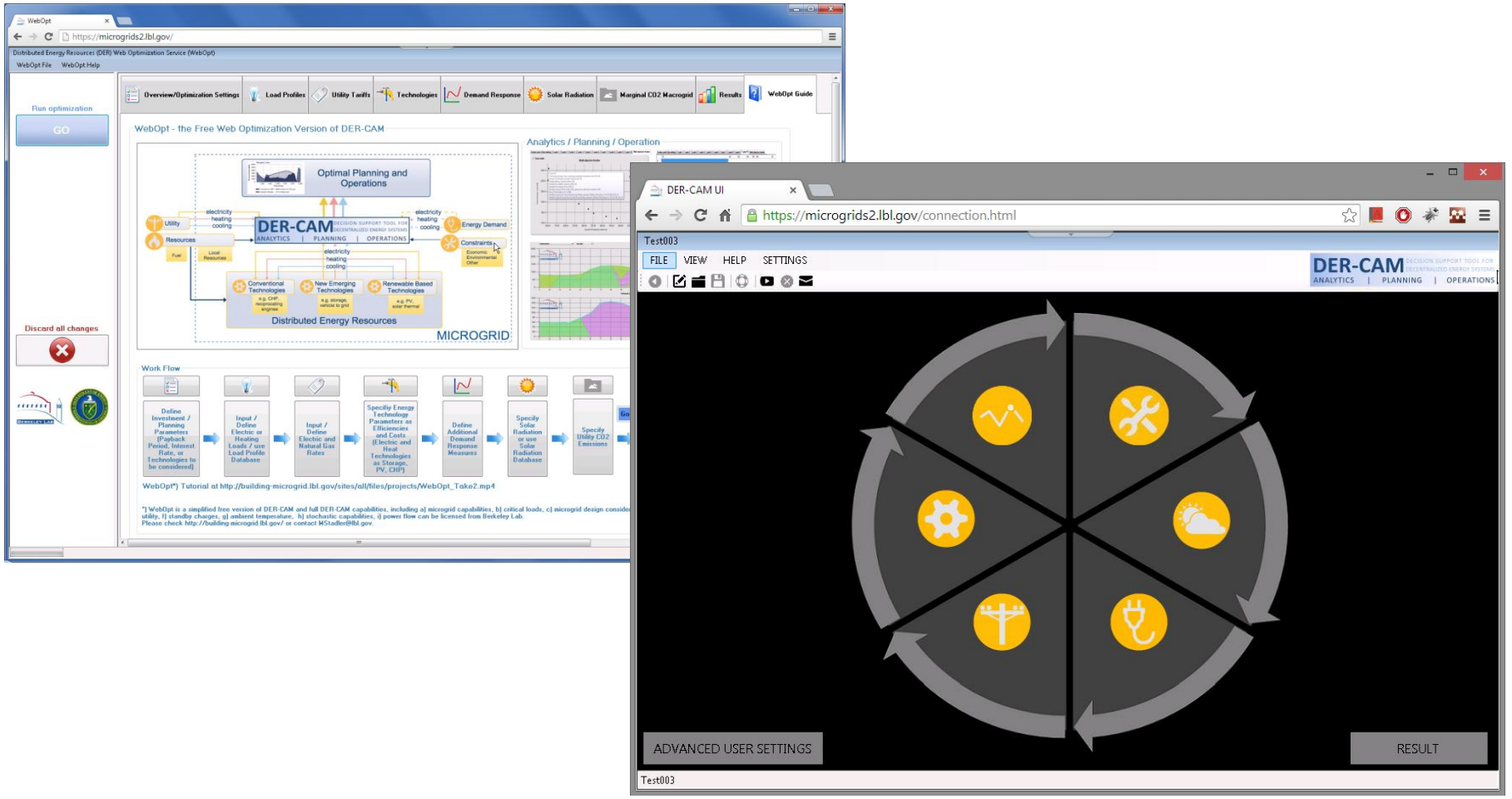

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Our Partners

Fort Hunter Liggett (FHL) – I+P DER-CAM Test Case

Overview

- large training facility for combat support and combat service support units of the Army Reserve
- existing DER: 2MW PV + 1MWh battery
- future: large (>3 MW) PV and battery system

Objective: enable Microgrid capabilities for short and medium-term outages

DER-CAM Contribution

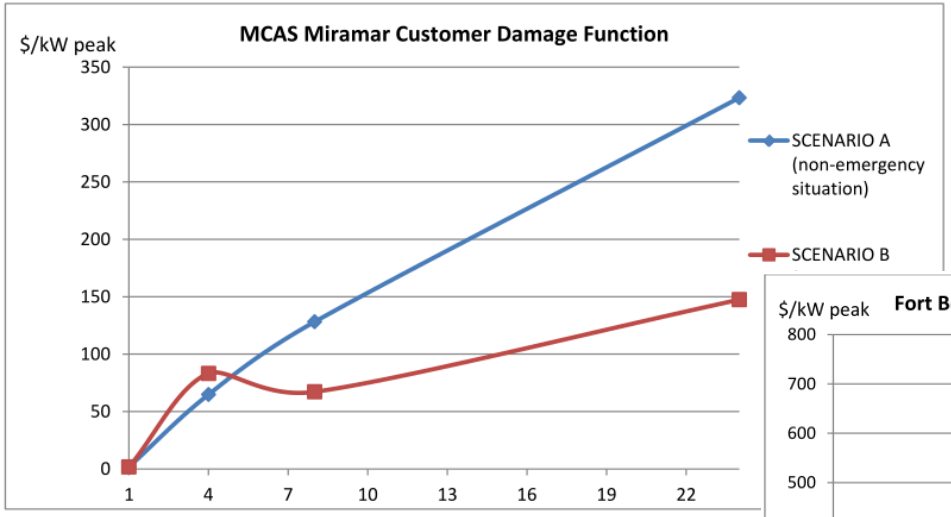
- use DER-CAM to gauge optimal capacity of DER considering outages
  - additional PV and storage
  - backup generation & other DER

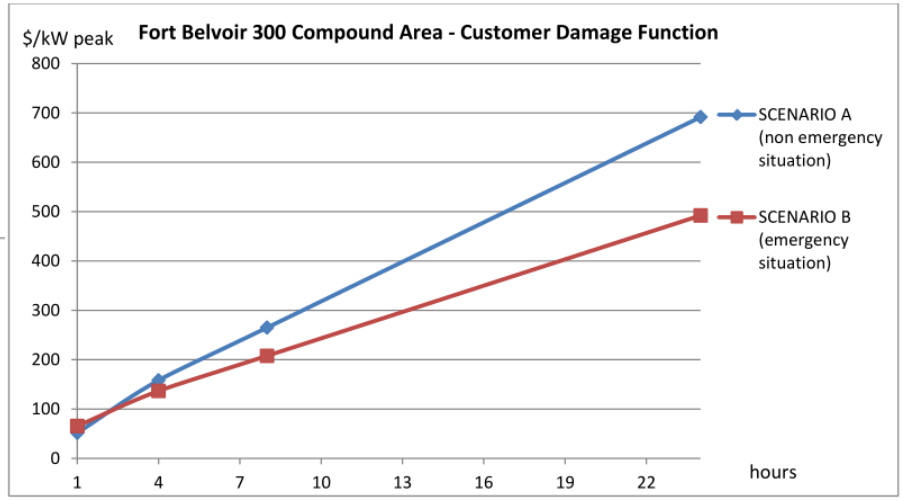
source: http://www.liggett.army.mil/

Fort Hunter Liggett – Customer Damage Function (CDF)

Customer Damage Function is used to estimate outage costs as a function of the outage duration.

*Value of Electrical Energy Security (VEES) ~ Outage Duration * $/kW peak * Peak Demand*





Source:
Valuing Energy Security: Customer Damage Function Methodology and Case Studies at DoD Installations, NREL

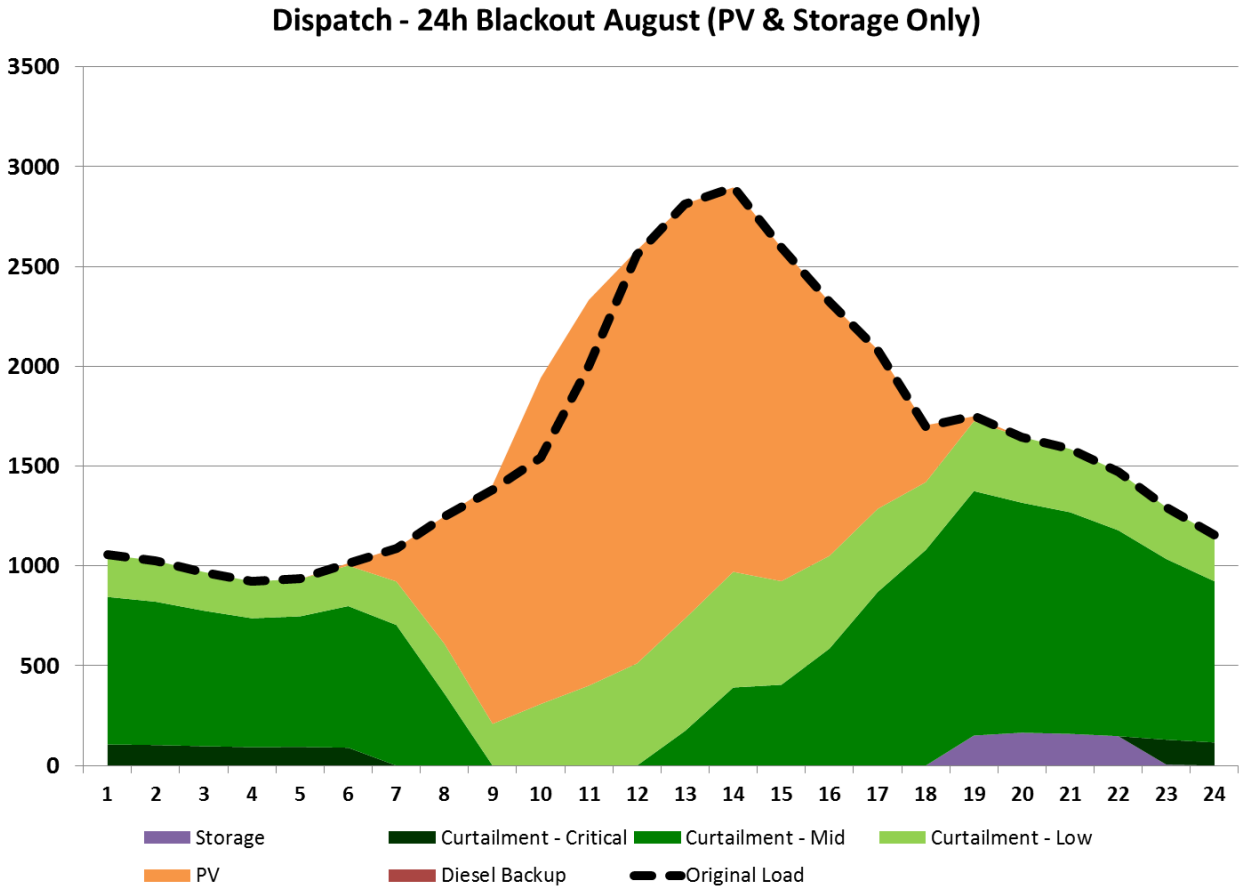
Fort Hunter Liggett – DER-CAM assessment - 24h blackout

Key Results

(Costs in million USD)	Existing PV and Storage	Existing PV, Storage + Diesel Backup	Additional PV, Storage and Diesel Backup	All DER
TOTAL COSTS	5.363	3.068	2.976	2.702
Electricity Costs	2.216	2.216	1.661	1.145
Fuel Costs	0.320	0.326	0.324	0.477
Annualized Capital Costs	0.491	0.510	0.971	0.976
O&M Costs	0.001	0.001	0.001	0.036
CDF Costs	2.330	0.009	0.010	0.000
Annual CO_2, ton	4955	4973	4119	4444
Installed Capacity				
Photovoltaic, kW	2000	2000	3106	2077
Electric Storage, kWh	1000	1000	4374	1250
Diesel Backup, kW	-	1400	1000	-
ICE, kW	-	-	-	2000
ICE HX, kW	-	-	-	500
Absorption Chiller, kW	-	-	-	2807
Solar Thermal, kW	-	-	-	801

- Results show that additional PV and storage, in addition to backup generation, will allow FHL to survive 24h outages without any major service disruption at low costs – diesel consumption roughly 1250 gallon for 24h
- When considering all DER options, the optimal investment solution allows enough flexibility to maintain operation during 24h outages and lowest costs

Fort Hunter Liggett – 24h blackout

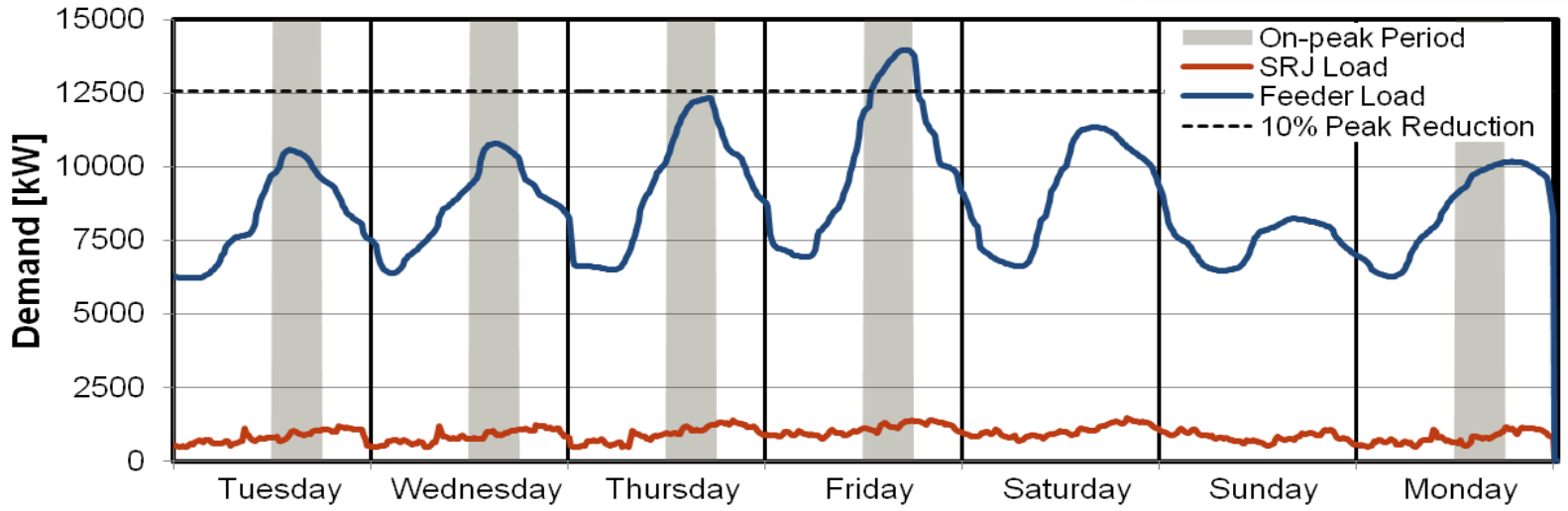


With the current PV and storage capacity alone, FHL would have severe curtailments in the event of a 24h outage, and would not be able to supply all critical loads

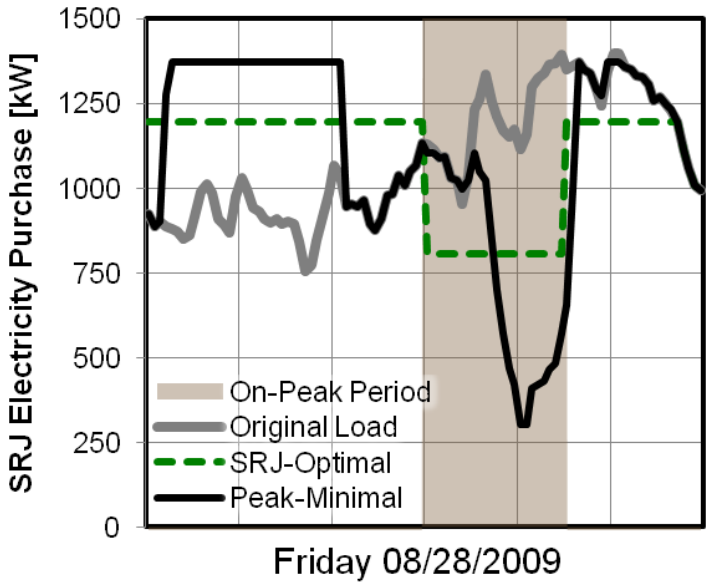
Santa Rita Jail – Operations DER-CAM Test Case

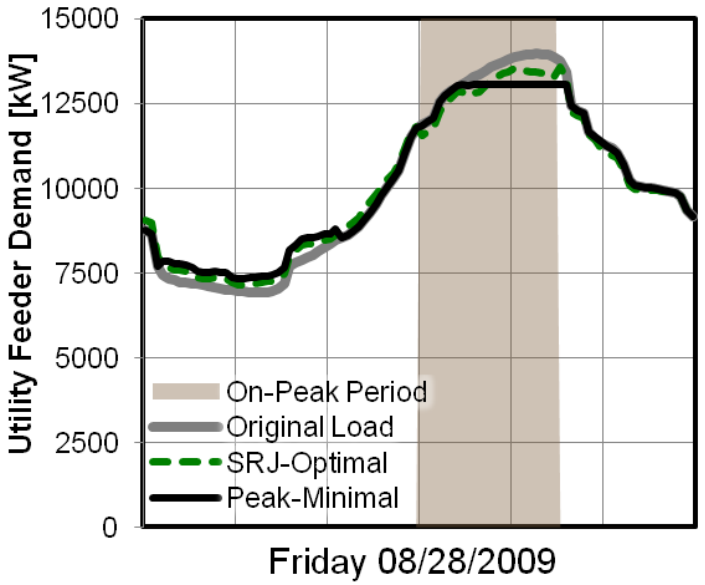
Overview
- 4,500 inmate facility; 3MW Peak load
- existing DER: 1.2 MW PV + 4 MWh / 2MW battery

Objective: evaluate potential contribution for feeder peak reduction



Santa Rita Jail – Operations DER-CAM Test Case





	SRJ-optimal	Peak-minimal
Energy Cost	$54,662	$54,721
Power Cost	$20,928	$25,990
Peak Reduction	2.7%	6.5%

THE END

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